

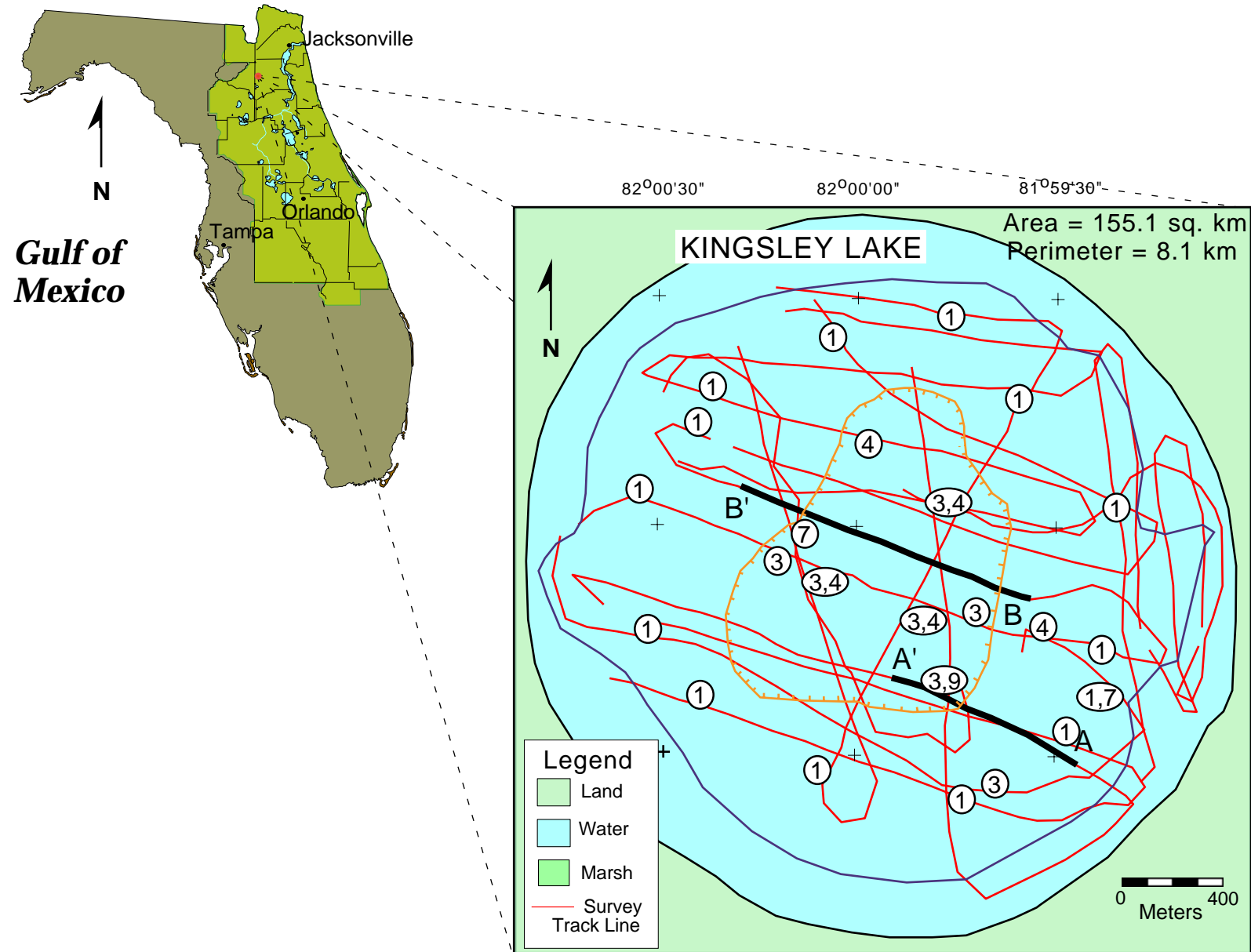


GEOLOGIC CHARACTERIZATION OF KINGSLEY LAKE CLAY COUNTY, FLORIDA

By
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INTRODUCTION

The potential fluid exchange between lakes of northern Florida and the Floridan aquifer and the process by which exchange occurs is of critical concern to the St. Johns River Water Management District (SJRWMD). High-resolution seismic tools with relatively new digital technology were utilized in collecting geophysical data from > 40 lakes and rivers. The data collected shows the application of these techniques in understanding the formation of individual lakes and rivers, thus aiding in the management of these natural resources by identifying breaches or areas where the confining units are thin or absent between the water bodies, the Intermediate aquifer and the Floridan aquifer.

This study was a cooperative investigation conducted from 1993 to 1996 by the SJRWMD and U.S. Geological Survey Center for Coastal Geology (USGS). Since 1989 there have been technical and hardware advances in the digital acquisition of high-resolution seismic data. The primary objective of this cooperative was to test newly developed digital high-resolution single-channel marine seismic continuous-profiling equipment (HRSP) and apply this technology to identify subbottom features that may enhance leakage from selected lakes and the St. Johns River. The target features include: (1) identifying evidence of breaches or discontinuities in the confining units between the water bodies and the aquifer, and, (2) identifying areas where the confining unit is thin or absent.

METHODS

In cooperation with SJRWMD the USGS acquired and upgraded a digital seismic acquisition system. The Elics Delph2 High-Resolution Seismic System was acquired with proprietary hardware and software running in real time on an Industrial Computer Corp. 486/33 PC. Hard-copy data was displayed on a gray scale thermal plotter. Digital data was stored on a rewritable Magneto-Optical compact disk. Navigation data was collected using a Trimble GPS or PLGR (Rockwell) GPS. GeoLink XDS mapping software was used to display navigation.

The acoustic source was the Huntex Model 4425 Seismic Source Module and a catamaran sled with an electromechanical device. Occasionally, an ORE Geopulse power supply was substituted for the Huntex Model 4425. Power was set at 60 joules or 135 joules depending upon conditions. An Innovative Transducers Inc. ST-5 multi-element hydrophone was used to detect the return acoustical pulse. This pulse was fed directly into the Elics Delph2 system for storage and processing.

Fifty line-km of HRSP data was collected from Kingsley Lake. A velocity of 1500 meters per second (m/s) was used to calculate a depth scale for the seismic profiles. Measured site specific velocity data is not available for these sites.

These surveys were conducted in part to test the effectiveness of shallow-water marine geophysical techniques in the freshwater lakes of central Florida. Acquisition techniques were similar but modifications were necessary. Data quality varied from good to poor with different areas and varying conditions. As acquisition techniques improved so did data quality in general. In many areas an acoustic multiple masked much of the shallow geologic data.

PHYSIOGRAPHY

Kingsley Lake is in west central Clay County, Florida. The lake is located in the Trail Ridge area of Sea Island District. Lake level at the time of the seismic survey was 53.7 m (176 ft) NVGD. Kingsley Lake is a circular lake approximately 3.2 km in diameter with a of perimeter 12.8 km and the surface area 5.6 sq km, with the deepest portion (40 ms, ~30 meters) of the lake in the southeast of the center where a large, steep sided, collapse sinkhole is located. Otherwise, the lake is shallow around the shoreline, gradually deepening to 6 meters. As the center of the lake is approached, the lake bottom slope steepens and increases in depth from 6 to 15 meters.

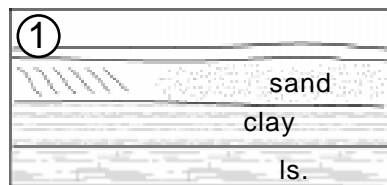
GEOLOGIC CHARACTERIZATION

Profile A-A' is an example of the seismic data for the primary sinkhole in the middle of Kingsley Lake. An abrupt change in slope can be seen on the flanks of the subsidence. This is a filled, collapse sinkhole with steep flanks overlain by offlapping fill and slumps. The fill is acoustically transparent with few low amplitude horizons discernible. This is to be expected since the source of the fill is primarily clean quartz sands brought in from the adjacent Trail Ridge Deposits. Plotted on the Kingsley Lake survey trackline map are the karst features identified from seismic profiles of Kingsley Lake. Types 1, 3, 4, 7, and 9 karst features were found. Features 3, 4 and 3.4 represent the primary sinkhole surrounded by Type 1 undisturbed depositional layers. No evidence of active subsidence was located within Kingsley Lake though minor, isolated, small scale, subsidence type features were found. The sediment plug within this main sinkhole is relative smooth and less disturbed compared to the smaller but active subsidence features of Orange Lake.

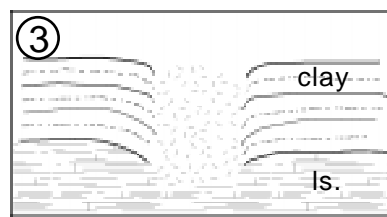
The Type 3.9 feature seen in Profile B-B' appears to be a secondary collapse feature that occurred after the formation of the main doline shown in Profile A-A'. Unlike the main doline, this feature is not completely filled with sediment. The data does not indicate that the feature extends through the surficial and Hawthorn Group sediments to the Floridan aquifer (>95 meters).

There is only limited borehole data available to correlate the seismic data. It is estimated that the top of the Floridan aquifer should be seen in the data at approximately 150 milliseconds. None of the profiles contained data that was resolvable at that depth however.

EXPLANATION



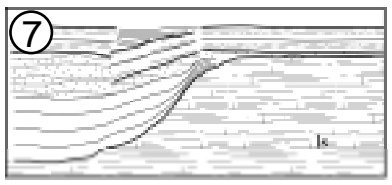
Undisturbed section, with or without upper non-reflective sand layer. Sand layer may show reflection where cross bedding from original deposition (fluvial or aeolian) exists. Clay layers are mostly intact.



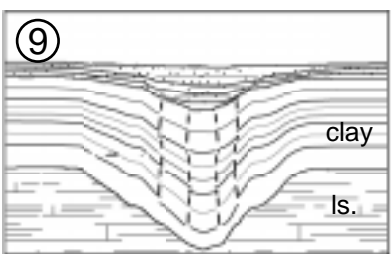
Horizontal reflectors continuous on either side of a central non-reflective zone. Horizontal layers bend downward towards the central zone. These features are representative of filled collapse sinks. The size may range from tens of meters to kilometers across a lake basin.



Low angle, subsidence depressions. Parallel reflectors are relatively intact. Horizontal reflectors onlap onto the subsided parallel reflectors and represent deposition during subsidence. These can be large basin size features or tens of feet.



Mid- to high-angle parallel reflectors with indications of vertical displacement and rotation. Feature may be buried by overburden. Represents blocks from the sides of collapse sinks that have slumped into the sink.



Low- to mid-angle subsidence depressions. Parallel reflectors have undergone displacement and rotation, creating stress fractures and faulting within the depression. The subsidence may or may not be filled with overburden.

